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Relativistic kinetics of phonon gas in superfluids

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Abstract

The relativistic kinetic theory of the phonon gas in superfluids is developed. The technique of the derivation of macroscopic balance equations from microscopic equations of motion for individual particles is applied to an ensemble of quasi-particles. The necessary expressions are constructed in terms of a Hamilton function of a (quasi-)particle. A phonon contribution into superfluid dynamic parameters is obtained from energy-momentum balance equations for the phonon gas together with the conservation law for superfluids as a whole. Relations between dynamic flows being in agreement with results of relativistic hydrodynamic consideration are found. Based on the kinetic approach a problem of relativistic variation of the speed of sound under phonon influence at low temperature is solved.

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Keywords

Kinetic equation, Phonon gas, Superfluids